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ANTIBODIES TO LEPTOSPIRAE IN ZOO ANIMALS IN GERMAN DEMOCRATIC REPUBLIC

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Abstract. A total of 1 038 zoo animals were examined for the presence of antibodies to leptospirae in the German Democratic Republic in the years 1973—1979. Positive antibody tests occurred in 47 (4.5 %) animals, including 39 (6.4 %) mammals and 8 (1.8 %) birds. Antibodies to leptospirae of the following serogroups were detected: *Australis*, *Autumnalis*, *Ballum*, *Grippotyphosa*, *Icterohaemorrhagiae*, *Javanica*, *Pomona* and *Sejroe*, in co-agglutinations *Bataviae*, *Canicola* and *Tarassovi*. The strongest positive reactions were observed in ruminants and carnivora. The low number of positive animals with a low level of agglutinins not exceeding the titre of 400 showed that the leptospirae represent no significant infective agents for animals kept in Middle-European zoological gardens.

Exotic animals kept in zoological gardens are usually examined for leptospirosis only in case of enzootic occurrence of this zoonosis in some of the animal species (Mettler and Weilenmann 1974) or in case of professional infection of zoo workers (Anderson et al. 1978). In a previous investigation (Schröder 1966) leptospiral antibodies were demonstrated in 7 cases in a group of 172 zoo animals.

The investigations dealt with in the present paper were carried out on a large scale. Their goal was to provide an information on the distribution of leptospirae among exotic animals and to evaluate the epidemiological and epizootiological significance of leptospirae under conditions of zoological gardens in Middle Europe.

MATERIAL AND METHODS

Blood samples were taken from animals of seven zoological gardens in the German Democratic Republic and examined for toxoplasmosis (Ippen et al., 1981) and leptospirosis using the method recommended by WHO Expert Committee on Zoonoses (Šebek 1964). The material was then processed in the laboratory after Šebek et al. (1972). The methods used for the selection of leptospiral serovars for microscopical agglutination reaction and the evaluation of this reaction were described by Šebek et al. (1972, 1976 a, b).

RESULTS

Of the total number of 1 038 animals, 47 (4.5 %) developed antibodies to some of the serovars used at the titre of 100 or higher. Positive reactions were seen in 8 (1.8 %) of 434 birds and in 39 (6.4 %) of 604 mammals examined. Significant titres (> 800) were recorded in 3 birds and 21 mammals.

Dominating serovars were *L. grippotyphosa*, and of the serogroup *Icterohaemorrhagiae*, closely related *L. icterohaemorrhagiae* and *L. copenhageni*, then *L. sejroe* and

L. bratislava. Rarely occurred *L. bulgarica*, *L. castellonis*, *L. pomona* and in co-agglutinations others, antigenically relative with dominating serovars, which are not mentioned in the results. An exception were the results with Sika deer (*Cervus nippon*) and barasingha (*Cervus* (*Rucervus*) *duvanceli*), in which the titres (800 and 400) of antibodies to *L. sorex-jalna* were higher than to antigenically relative *L. icterohaemorrhagiae* or *L. copenhageni*. It could not be judged from a single examination whether the infection with this serovar was involved.

For better evaluation the animals were divided into groups comprising a higher number of samples according to their zoological classification. The group Alia included 11 families with a small number of samples which were negative in our examinations.

The serological positivity of animals in individual groups was strongly influenced by the unequal number of animals examined. The small number of Marsupialia, Chiroptera, Pinnipedia, Insectivora and Suidae examined was the reason why no positive result was recorded, in spite of the fact that Insectivora and Suidae include species which are considered to be natural reservoirs of some serovars of leptospirae. On the other hand, the single positive case among the small number of giraffes examined indicated an apparently high infection rate in these ruminants (Table 1). However, the ruminants, as well as carnivora, are groups with the highest infection rate (Tables 1 and 2). Among the birds, only 3 families (Ciconiidae, Anatidae, Paradisaeidae) comprised species positive to leptospirae.

Table 1. Survey of examined animals and their seropositivity

	Species, subspecies, or races	No. of examined animals	No. of positive animals	Positivity (%)
Aves				
Gruiformes	12	36	0	0
Anseriformes	22	142	5	3.5
Ciconiiformes	20	53	2	3.8
Falconiformes	14	16	0	0
Psittaciformes	15	28	0	0
Galliformes	12	30	0	0
Passeriformes	10	31	1	3.2
Alia	33	98	0	0
Mammalia				
Marsupialia	5	15	0	0
Chiroptera	1	2	0	0
Insectivora	1	2	0	0
Simiae	16	32	1	3.1
Hystricidae	1	1	0	0
Lagomorpha	8	26	1	3.8
Carnivora	36	98	8	8.1
Pinnipedia	1	2	0	0
Perissodactyla	11	31	1	3.2
Suidae	3	8	0	0
Giraffidae	3	7	1	14.3
Camelidae	5	39	6	12.8
Cervidae	24	118	7	5.9
Bovidae	37	223	14	6.3
Total	290	1 038	47	

Table 2. Survey of seropositive animals with reciprocal value of antibody titre

Animal	Leptospira serogroups							
	Ict	Jav	Bal	Aut	Aus	Pom	Gri	Sej
Branta ruficollis	200	0	0	0	0	0	800	0
Tadorna tadornoides	0	0	0	0	0	0	400 800	0
Aix sponsa	0	0	0	0	0	0	0	1 600
Ciconia ciconia	100 200	0	0	0	0	0	0	0
Paradisea apoda	0	0	100*	0	100*	0	0	0
Gorilla gorilla	0	0	0	0	0	0	0	1 600
Oryctolagus cuniculus	0	0	0	0	0	0	100	0
Paradoxurus hermaphroditus	0	0	0	0	200	0	0	0
Panthera pardus	0	0	0	0	0	0	400	0
Puma concolor	0	0	0	0	0	0	200	0
Canis familiaris	100	0	0	0	0	0	1 600	0
Canis aureus	3 200	0	0	0	0	0	0	0
Ursus arctos	0	0	0	0	100	0	0	0
Suricata suricata	100	0	0	0	0	0	0	0
Equus quagga	0	0	0	0	1 600	0	0	0
Giraffa camelopardalis	0	0	0	0	0	0	1 600	0
Camelus ferus	0	0	0	0	0	0	0 100	800 12 800
Llama glama	0	0	0	0	0	400	3 200	400
Cervus nippon	0	800**	0	0	0	0	0	0
Odocoileus hemionus	0	0	0	0	0	0	6 400	0
Cervus duvanceli	0	400**	0	0	0	0	0	0
Axis porcinus	400	0	0	0	0	0	0	0
Cervus elaphus	0	0	0	0	0	0	1 600	0
Capreolus capreolus	0	0	0	0	0	0	800	6 400
Bison bonasus	0	0	800	0	0	0	400	0
Poephagus grunniens	400	0	0	0	400	0	0	0
Tragelaphus angasi	0	0	0	0	400	0	0	0
Taurotragus oryx	0	0	0	0	0	0	1 600	0
Connochaetes taurinus	800	0	0	0	0	0	0	0
Capra hircus	800	0	0	800	0	0	0	0
Ovis ammon	400	0	0	0	400	0	800	1 600
Damaliscus dorcas	800	0	0	0	0	0	0	0

Order of serogroups: *Icterohaemorrhagiae*, *Javanica*, *Ballum*, *Autumnalis*, *Australis*, *Pomona*, *Grippotyphosa* and *Sejroe*.

* Detection of both serovars at identical titre.

** Antibody titre by one grade higher than serovars of the serogroup *Icterohaemorrhagiae* (see text).

DISCUSSION

The zoological garden represents an artificial ecosystem. From the epidemiological and epizootiological viewpoint, interfering effects from the surrounding urban and suburban environment are introduced there by the visitors, zoo workers, free-living and domestic animals (dogs, cats, mice, guinea pigs), fodder, water etc. The introduction of leptospirae by the zoo animals themselves is little probable. This is indicated not only by the composition of serovars detected, but also by the fact that very few animal species are supplemented by importing newly caught specimens. Consequently, the fundamental source of leptospiral infection are rodents and water contaminated by them (WHO 1967). The infective agents are the serovars commonly occurring in Middle Europe.

The dominating serovar in all groups of animals with leptospiral antibodies was *L. grippotyphosa*. Similarly as observed by Šebek and Rosický (1975) in deers in Czechoslovakia and Austria,* the prevalence of this serovar was found not only in deers, but also in all ruminants. The serovar of the serogroup *Icterohaemorrhagiae* was also very frequent in these animals. Remarkable is the presence of antibodies to *L. sorex-jalna* in Sika deer (*Cervus nippon*) and barasingha (*C. duvanceli*), which was reported also by Šebek et al. (1976 a) in *Capreolus capreolus*. In the USA, *L. pomona* was most abundant in 8.3 % of seropositive deers in the years 1973—1974 (Harrington 1975), whereas in Australia, Durfee and Presidente (1979) recorded 68.4 % of rusa deer (*Cervus timorensis*) to be infected with *L. hardjo*. Twigg et al. (1973), who examined deers in Great Britain, did not consider leptospirosis in free-living ruminants to be of a great importance from the epidemiological point of view.

Among Camelidae the highest prevalence of antibodies was found in the llama. In addition to *L. grippotyphosa* and *L. pomona*, antibodies to *L. sejroe* were detected in three specimens of this family; two of them were Bactrian camels (in one case the titre reached 12 800). The occurrence of this and other serotypes in Afghanian camels was reported also by Šebek et al. (1978).

Among the cattle, antibodies to *L. grippotyphosa* and *L. castellonis* were detected in European bisons, and to *L. copenhageni* and *L. bratislava* in yaks. With the exception of *L. bratislava*, the same antibodies, together with those to the serogroups *Bataviae*, *Canicola*, *Hebdomadis*, *Pomona* and *Tarassovi*, were detected in cattle and buffaloes in Afghanistan by Šebek et al. (1978). The infection rate was surprisingly high, 25.5 or 55 %.

Although in goats and sheep the infection rate is not very high (Šebek 1974, Harrington 1975), we have found the agglutinins in six animals of various races. Cameroon dwarfish goats seem to be susceptible to leptospiral infection, as it was previously indicated by examinations in a zoological garden in Czechoslovakia (unpublished data).

Another group with a frequent occurrence of leptospiral antibodies are the carnivora. Antibodies to *L. grippotyphosa* were detected in leopard, puma and a Central-American race of domestic dog, to serovars of the serogroup Icterohaemorrhagiae in two other canines and to *L. bratislava* in bear. A transmission of leptospirosis from bears to zoo workers in the USA was reported by Anderson et al. (1978). Marler et al. (1979) registered 10 % positivity in coyotes, with *L. grippotyphosa* asprevailing serovar.

Of other species, which were only rarely positive, the case of *L. sejroe* infection (titre 1 600) in gorilla should be mentioned.

* Only data obtained from free-living species can be compared, as the bred animals were not examined on a large scale for the presence of leptospiral antibodies.

Leptospirosis in birds has been only sporadically reported in the literature. In our studies, we have found only occasional cases, particularly among the water birds. It is of interest that out of the 22 examined species and subspecies of the order Anseriformes, positive specimens were only of the genera *Aix*, *Branta* and *Tadorna*.

Leptospiral antibodies were detected only in 4.5 % of animals. The examinations were carried out during seven years. This fact indicates that the role of leptospirosis in zoo animals is insignificant. However, the possibility of its occurrence (Mettler and Weilenmann 1974) should be considered in case of disorders in various mammals.

АНТИТЕЛА К ЛЕПТОСПИРАМ У ЖИВОТНЫХ В ЗООПАРКАХ В ГЕРМАНСКОЙ ДЕМОКРАТИЧЕСКОЙ РЕСПУБЛИКЕ

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Резюме. В 1973—1979 гг. обследовали на лептоспироз 1 038 животных в семи зоопарках в Германской демократической республике. Положительные реакции наблюдались у 47 (4,5 %) животных, в том числе у 39 (6,4 %) млекопитающих и 8 (1,8 %) птиц. Обнаружены антитела к лептоспирам следующих серологических групп: *Australis, Autumnalis, Ballum, Grippotyphosa, Icterohaemorrhagiae, Javanica, Pomona* и *Sejroe*, в соагглютинациях *Bataviae, Canicola* и *Tarassovi*. Самые сильные реакции встречались у жвачных и плотоядных животных. Небольшое количество положительно реагирующих животных с низким уровнем агглютинации (титр не больше 400) свидетельствует о том, что лептоспиры не имеют значения как инфекционный агент у животных в зоопарках средней Европы.

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